Topography improvements in MEMS DMs for high-contrast, high-resolution imaging, Phase I

Completed Technology Project (2012 - 2012)

Project Introduction

This project will develop and demonstrate an innovative microfabrication process to substantially improve the surface quality achievable in high-resolution continuous membrane MEMS deformable mirrors (DMs). Project specific aims include 2X improvement in small-scale surface flatness in comparison to the current state-of-the-art, and substantial reductions in sub-aperture scale diffractive losses due to actuator print-through, mirror scallop, and etch access hole scatter in continuous membrane MEMS DMs. Such wavefront control devices will fill a critical technology gap in NASA's vision for high-contrast, high-resolution space based imaging and spectroscopy instruments. Space-based telescopes have become indispensible in advancing the frontiers of astrophysics. Over the past decade NASA has pioneered coronagraphic instrument concepts and test beds to provide a foundation for exploring feasibility of new approaches to high-contrast imaging and spectroscopy. From this work, NASA has identified a current technology need for compact, ultra-precise, multi-thousand actuator DM devices. Boston Micromachines Corporation has developed microelectromechanical systems (MEMS) DMs that represents the state-of-the-art for scalable, small-stroke high-precision wavefront control. The emerging class of high-resolution DMs pioneered by the project team has already been shown to be compact, low-power, precise, and repeatable. These DMs can be currently produced with uncorrectable shape errors as small as 10nm root mean square (rms). These residual shape errors on the DM are mostly periodic and act essentially as a grating, producing diffraction spikes in the image plane. In the proposed project, we will develop processes and manufacturing innovations that collectively reduce or eliminate these shape errors through improved chemo-mechanical polishing, stress compensation film deposition, and elimination of etch access holes, resulting in a MEMS DM with unprecedented surface quality.

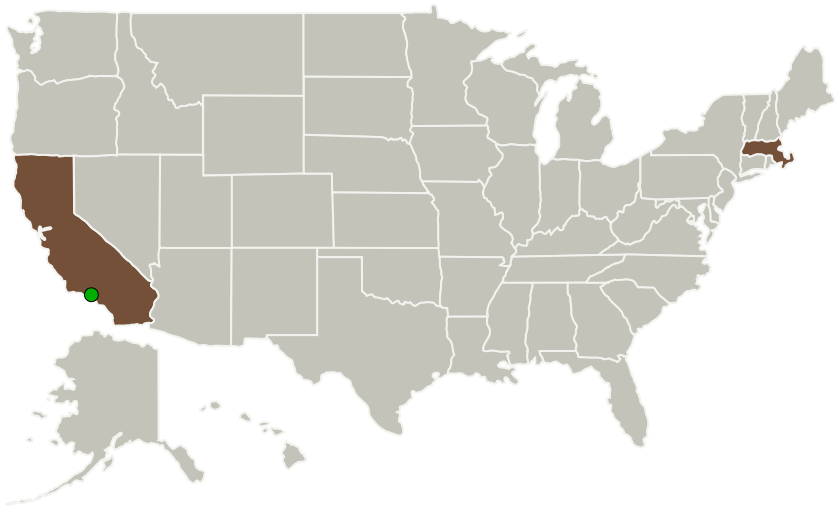
Topography improvements in MEMS DMs for high-contrast, high-resolution imaging, Phase I

Table of Contents

Topography improvements in MEMS DMs for high-contrast, high-resolution imaging, Phase I

Completed Technology Project (2012 - 2012)

Primary U.S. Work Locations and Key Partners



Organizations Performing Work	Role	Type	Location
Boston Micromachines Corporation	Lead Organization	Industry	Cambridge, Massachusetts
Jet Propulsion Laboratory(JPL)	Supporting Organization	NASA Center	Pasadena, California

Primary U.S. Work Locations	
California	Massachusetts

Project Transitions

February 2012: Project Start

August 2012: Closed out

Closeout Documentation:

- Final Summary Chart*(https://techport.nasa.gov/file/137354)*

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

Boston Micromachines Corporation

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Steven A Cornelissen

Co-Investigator:

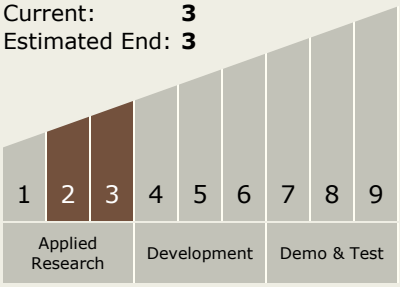
Steven Cornelissen

Topography improvements in MEMS DMs for high-contrast, high-resolution imaging, Phase I

Completed Technology Project (2012 - 2012)

Technology Maturity (TRL)

Start: **2**
Current: **3**
Estimated End: **3**



Technology Areas

Primary:

- TX08 Sensors and Instruments
  - TX08.2 Observatories
    - TX08.2.1 Mirror Systems

Target Destinations

The Moon, Mars, Outside the Solar System, The Sun, Earth, Others Inside the Solar System